schools might increase humeral torsion on the dominant shoulder. The objective of this study was to assess the effect of baseball position in youth and adolescent athletes on humeral torsion.
Materials and Methods: We studied 153 high school baseball players who began to play baseball in elementary school at the age of 8.1 ± 1.6 years old. All subjects completed questionnaires about their baseball experience, throwing activity, and past injuries; they then were physically examined. We divided them into four groups according to their baseball positions in elementary and junior-high schools: 35 players were pitchers in both elementary and junior-high school (group 1), 32 players were pitchers in elementary school but fielders in junior-high school (group 2), 17 players were fielders in elementary school but pitchers in junior-high school (group 3), and 69 players were fielders in both elementary and junior-high school (group 4). Humeral torsion was assessed bilaterally by using ultrasound. Humeral torsion was defined as the angle between the long axis of the forearm and a line parallel to the trunk, when the line tangential to the bicipital groove was parallel to the horizontal baseline in supine position with the shoulder at 90° abduction, the elbow at 90° flexion, and the forearm in the neutral position.
Results: Beginning age of baseball did not differ significantly among four groups. Among the 153 high school baseball players, 113 players (73.9%) had history of shoulder or elbow injuries. Humeral torsion was significantly greater ($p<0.01$) on the dominant shoulder than on the non-dominant shoulder in all groups. Humeral torsion on the dominant shoulder was significantly greater ($p=0.03$) in group 1 than in group 4 (mean difference, 7.1°). A logistic regression analysis showed that humeral torsion on the dominant shoulder was not a predictive factor for shoulder and elbow injuries (odds ratio, 0.99; 95% confidence interval, 0.96 - 1.02; p value, 0.70).
Conclusions: In high school baseball players, humeral torsion was greater on the dominant shoulder than on the non-dominant shoulder. Players who played baseball as pitchers during both elementary and junior-high school had greater humeral torsion on the dominant side than did players who were fielders during both periods. Given that pitchers throws more frequently than do fielders, this study suggests that increased time pitching in youth and adolescent athletes increases the humeral torsion on the dominant shoulder. Increased humeral torsion on the dominant shoulder was not the predictive factor for shoulder and elbow injuries.
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B0239

A comparison of two superficial MCL reconstruction includiing single-bundle anterior cruciate ligament (ACL) reconstruction

J. Dong [1], J. Zhu [2], B. Marshall [2], M. Linde-Rosen [1], P. Smolinski [1,2], F.H. Fu [1]
[1]*Department of Orthopedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA*
[2]*Department of Mechanical Engineering and Material Science, University of Pittsburgh, PA, USA*

Introduction: Anterior cruciate ligament (ACL) and medial collateral ligament (MCL) are the most commonly injured ligaments in the knee, which serves as the primary medial stabilizer to anterior translation and valgus stress [1]. It is not uncommon for superficial medial collateral ligament (sMCL) damage to occur with ACL injury. While conservative treatment of the MCL injury is often done, in cases of severe injury, reconstruction of the sMCL can be done in addition to the ACL reconstruction. There are two MCL reconstructions (parallel and tri-vector) in clinic. But we don't know which technique can better restore the biomechanics of the intact knee. The objective of the study was to compare knee biomechanics of two sMCL reconstructions combined with single-bundle ACL reconstruction using a porcine model.
Methods: Twenty (n=20) fresh frozen unpaired adult pig knees were used for biomechanical testing. Specimens with a congenital abnormality or arthritis were excluded from the study and the existence of an intact ACL was confirmed arthroscopically. All specimens were frozen at -20 C^0, and thawed the night before testing at room temperature. The knees were kept intact and the specimens were kept moist with physiologic saline solution. The tibia and femur were sectioned ~15 cm from the joint line and the ends of femur and tibia were potted in heavyweight epoxy putty.
The specimens were divided into two groups, tested with the robotic testing system (CASPAR Orto MAQUET, Germany) under (1) an 89-N anterior tibial (AT) load at 30° (porcine full extension), 60°, and 90° of knee flexion, (2) 4-Nm internal and external tibial torques at 30° and 60°, and (3) a 7-Nm valgus torque at 30° and 60° of knee flexion [2, 3]. The groups were divided into either parallel or tri-vector group sMCL reconstruction and both groups had single bundle ACL reconstructions. The ACL reconstructions were performed with a 7 mm graft which was fixed with 60 N at 30° of flexion. The sMCL reconstructions were performed with 6 mm grafts and fixed with 44 N at 30° of flexion. The ACL reconstructions were done arthroscopically in an anatomic fashion with hamstring grafts and graft fixation was done with a screw and washer on the tibia and an extra-cortical button on the femur.
Differences in anterior tibial translation (ATT) displacement, internal / external rotation angles, and in situ forces at the different flexion angles where analyzed using one-way ANOVA with repeated measures, and statistical significance was set at $p < 0.05$.
Results and discussion: With ACL MCL co-injuries, ACL reconstruction alone can't restored ATT, valgus, internal or external rotation result. With ACL and two different sMCL reconstructions, no significant differences were found between two groups for ATT at 30° flexion, and both method restored intact knee biomechanics. At 60° and 90° of flexion, MCL tri-vector reconstruction can restore the ATT, while parallel MCL reconstruction cannot improve the ATT. Under valgus loading, ACL reconstruction alone did not restore intact knee stability, the parallel sMCL reconstruction did restore stability while the tri-vector method did not. Under the external tibial torque, parallel sMCL reconstruction does restore external rotation while tri-vector sMCL reconstruction does not restore. Under the internal tibial torque, both sMCL reconstruction techniques restored intact knee internal rotation.

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B0241

Morphological changes in the femoral tunnel aperture following anatomic MPFL reconstruction

K. Kita [1], Y. Tanaka [1], H. Amano [1], Y. Toritsuka [2], R. Uchida [3], Y. Shiozaki [3], S. Horibe [4]
[1]*Osaka Rosai Hospital, Japan*
[2]*Kansai Rosai Hospital, Japan*
[3]*Seihu Hospital, Japan*
[4]*Osaka Prefecture University, Japan*

Background: There has been only one study investigating the femoral tunnel enlargement after medial patellofemoral ligament (MPFL) reconstruction, while tunnel widening after anterior cruciate ligament (ACL) reconstruction is a well-known phenomenon. The purpose of this study was to evaluate the morphological change at the aperture of the femoral tunnel after anatomic MPFL reconstruction with hamstring tendon graft using three dimensional computed tomography. Our hypothesis was that morphological changes including tunnel enlargement would occur in anatomic MPFL reconstructions as in anatomic ACL reconstructions.
Method: From July 2012 to September 2014, 23 patients with recurrent patellar dislocation who performed anatomic MPFL reconstruction were prospectively enrolled in this study. They were 6 males and 17 females with a median age of 24 years (range, 14-53). All study protocols were approved by the local ethics committee. All reconstructions were performed using a modified "dual tunnel MPFL reconstruction" technique, as described previously. Briefly, a semitendinosus tendon autograft was harvested. Then, two patellar bone sockets and one femoral tunnel were created anatomically under X-ray control. Finally, the graft was inserted and fixed with cortical suspension devices. The knee was immobilized for 2 weeks following surgery and weight-bearing was gradually increased to full at 4 weeks. Running was allowed at 3 months, followed by a return to previous sporting activity at 6 months. Computed tomographic scans obtained at two weeks and a year after surgery were reconstructed into 3D constructs using the volume analyzer SYNAPSE VINCENT® (Fujifilm Medical, Tokyo, Japan). Cross sectional areas (CSA) and locations of center, anterior border, posterior border, distal border, and proximal border of the femoral tunnel were compared between the two periods. CSA was measured on the plane perpendicular to long axis of the femoral tunnel. A true medial view of the femur was established by superimposing the posterior aspects of the femoral condyles. The distance (D) from the anterior border to the posterior border of the femoral condyle was defined as 100% and we created coordinate axes. Anterior-to-posterior and proximal-to-distal positions were calculated as percentages of the distance (D). The Wilcoxon signed rank test was used to compare the values of the two periods.
Results: CSAs of the aperture of the femoral tunnel at 2 weeks and 1 year after surgery were 21.7 ± 2.8 mm^2 and 30.3 ± 7.1 mm^2, respectively ($P < 0.01$). The average CSA significantly increased by 41.1 ± 34.7 % (range, -6 - 103 %) at 1 year after surgery compared with 2 weeks after surgery. The center and the anterior border of the femoral tunnel significantly shifted in the anterior direction at 1 year after surgery. The proximal border significantly shifted in both anterior and proximal directions and the distal border shifted in both anterior and distal directions. The posterior border did not significantly shifted.
Discussion: The study revealed two important findings. First was that the CSA of the femoral bone tunnel enlarged in MPFL reconstruction by using 3DCT. Berard et al. reported that 2x tunnel enlargement was noted in 41.8% after MPFL reconstruction using plain X-ray. The finding is in accordance with the current result and tunnel enlargement due to graft tunnel motion, such as the bungee cord effect and windshield wiper effect, would occur in MPFL reconstruction as in ACL reconstruction. The other important finding of the study, which has not been reported previously, was that the tunnel aperture migrated anteriorly with time after surgery. The reason would be that the MPFL mainly functions from 0 to 30°of knee flexion and trochlea is primary restraint with additional flexion.
Conclusion: This is the first study investigating the morphological change of the femoral tunnel following MPFL reconstruction in detail using 3DCT. Surgeons need to take into account the fact that tunnel enlargement occurs in MPFL reconstruction. We believe that the knowledge of this phenomenon will contribute to further development of anatomic MPFL reconstruction. Limitations are as follows: (1) small sample size, (2) investigating only the aperture of the femoral tunnel, and (3) without clinical evaluations.
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B0242

Association of fibrosis in the infrapatellar fat pad and degenerative cartilage change of patellofemoral joint after anterior cruciate ligament reconstruction

K.H. Yoon, MD , D.H. Tak, MD , T.S. Ko, MD , S. Park, MD , S.H. Lee, MD
Department of Orthopaedic Surgery, Kyung Hee University School of Medicine, Seoul, South Korea

Background: The purpose of this study was to evaluate the prevalence and risk factor of cartilage degeneration of patellofemoral joint (PFJ) that was diagnosed by second look arthroscopy in the short term follow-up period.